Naval Health Research Center

San Diego, CA

NHRC UPDATE

October 1997 Issue No. 7

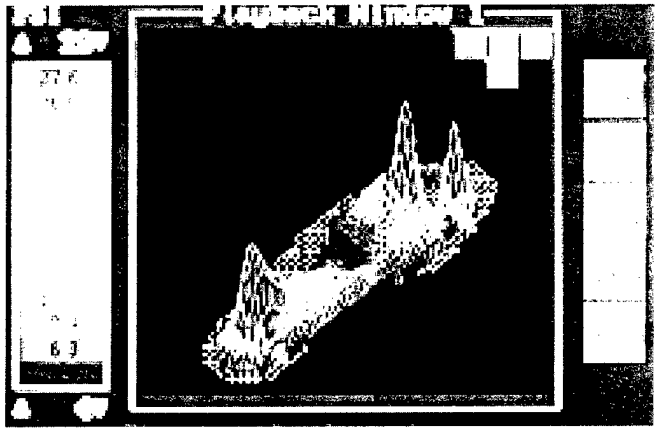
This update is published quarterly to highlight NHRC contributions to the Navy and Marine Corps as well as the scientific community.

NHRC Researchers Employ Cutting Edge Technology to Help Develop New Marine Boot

The combat boot is one of the most important pieces of the U.S. Marine Corps standard military issue. Military requirements demand a boot that is comfortable, durable, and enhances the performance capabilities of the marine. However, previous boot designs restricted natural gait patterns and provided minimal shock absorption during physical activity. These factors often led to an early onset of fatigue, muscular pain, and possible injury.

As part of an on-going program to reduce musculoskeletal injuries in Marine Corps and Navy training populations, researchers at NHRC were asked to collaborate with MARCORSYSCOM in the development of a new infantry combat boot for the Marine Corps. The NHRC research team included Captain Stephanie Brodine, MC, USN; Commander Rick Shaffer, MSC, USN; Commander Travis Luz, MSC, USN; and Ms. Karen Maxwell-Williams. This team worked with Dr Kenton Kaufman of the Biomechanics Laboratory at Children's Hospital, and John Hagy, a footwear expert, to evaluate the biomechanical aspects of current commercially available boots and stock system boots and to provide a recommendation for an improved design of a Marine Corps combat boot.

One of the biomechanical risk factors for a musculoskeletal injury is impact shock or shock waves generated by repeated impact between the foot and the ground. These shock waves, which are generated at the foot/shoe interface are transmitted through the musculoskeletal tissues of the lower limb and spine, are thought to be associated with many different kinds of musculoskeletal injuries. These injuries are particularly problematic in U.S. military recruit populations where individuals are exposed to sudden increases in the volume and intensity of physical training. Studies of these recruit populations have reported injury rates from 26% to 46% for male trainees and 45% to 54% for female trainees. These injuries frequently result in lost training time and medical attrition, producing a significant operational and fiscal burden.



The researchers from this multidisciplinary team tested existing Marine Corps leather and jungle boots for baseline performance characteristics and

compared them with a panel of commercially available high-tech boots. The biomechanical measurements fell into two categories: (a) physical tests aimed at mechanically characterizing the entire boot or the boot's component materials, and (b) tests using human subjects to quantify various physical properties and the body's response to wearing boots. The human biomechanical tests were selected on the basis of existing data correlating specific biomechanical characteristics and the likelihood for musculoskeletal overuse injury. Specific emphasis was placed on shock absorption, energy return, and stability. Biomechanical testing was also performed on a high-performance running shoe.

The prototype sole developed from these tests has a rubber Vibram outsole for durability and a polyurethane midsole and insole for cushioning. The shock

New stock system infantry combat boot

absorption and performance characteristics of these materials are significantly superior to the current military issue boots and similar to a running shoe. The final specifications for the new boot were derived from focus groups and wear tests with Marine Corps Infantry and Fleet Marine Force personnel. Features include a softer, more flexible leather which is waterproof, with a Gore-Tex membrane and Cordura uppers. In addition to the increased cushioning of the sole, there is increased cushioning throughout the boot with a semi-wedged midsole/outsole for better traction and ground contact. Another important feature is the revised lacing system that extends further down the toe to maximize foot fit and function.

The development of the new Marine Corps boot, scheduled to be in the stock system by November 1997, provides an excellent example of how Navy medical researchers at NHRC work hand-in-hand with operational forces, academics, and private industry to bring world class science to bear on solving operational problems in the Navy and Marine Corps.

Long-term NHRC Follow-up of Health and Readiness Shows Sailors Staying Fit

It has been estimated that more than 40% of all illness and premature death in the United States is directly related to personal life-style choices, particularly tobacco and alcohol use, fatty diet, and lack of exercise. With nearly half a million people on their active payroll, and more than one million retirees and dependent family members who are also health care beneficiaries, the U.S. Navy constitutes one of the nation's largest employers offering health care coverage to its personnel. As such, the Navy has a keen interest in reducing costly diseases of life-style, as well as in meeting the demand that its fighting force be fit, healthy, and ready to perform at all times. In 1982, the Navy established a comprehensive Health and Physical Readiness Program to promote health and physical fitness, set minimum standards for fitness and weight control, and emphasize the need for all active-duty personnel to participate in life-style behaviors that promote good health. Researchers at the Naval Health Research Center were instrumental in establishing the Navy's physical readiness standards, developing the methods and equations for assessing body fat, and initiating a comprehensive program to evaluate health promotion interventions, such as smoking cessation, alcohol rehabilitation, and weight control.

In a recent NHRC study to explore trends in health behaviors and physical readiness, Ms. Linda Trent and Ms. Suzanne Hurtado conducted a follow-up survey of over 5,500 Navy personnel who had participated in one or more of the earlier NHRC studies. This effort, which was supported by the Office of Naval Research, resulted in a sample of more than 2,000 participants with matched data from the 1983/1986 baseline studies and the 1994 follow-up. In this study both men and women demonstrated increased physical fitness over the years. These fitness changes

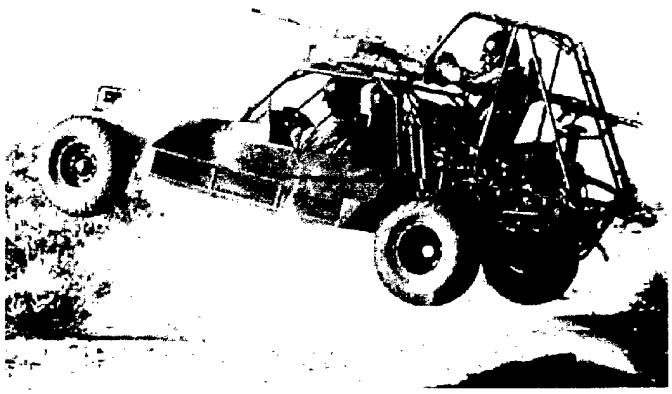
were measured in terms of age- and sex-adjusted classification scores on the 1.5-mile run, sit-ups, and push-ups tests. There was also a highly significant improve-

ment in dietary choices among both men and women over the 11 years of the study. Cigarette smoking and alcohol use declined significantly in men, particularly among those assigned aboard ship, while women showed no change in their use of either substance. At the end of the follow-up, there was no statistically significant difference between men and women in the percentage of smokers; however, women were drinking significantly less alcohol than men (about 2 drinks per week versus more than 4 drinks per week). The only significant fitness decrements were in body composition (2% increase in body fat) and a 7% increase in people reporting high blood pressure.

Overall, the authors found that these career Navy people were (1) maintaining a vigorous level of physical activity, (2) eating a significantly more healthful diet, (3) exhibiting markedly greater muscle mass, (4) sustaining body fat levels that remained within the Navy's established limits, and (5) demonstrating significantly improved physical fitness scores despite being 8 to 11 years older. Much of the credit for these effects is believed to be due to the fact that Navy personnel have been influenced by the Navy's health promotion program for more than a decade. The study concluded that these longitudinal participants represent the career naval force whose somewhat older, higher-ranked, service-committed personnel exemplify a new level of physical readiness and serve as models for more junior members of the fleet.

NHRC Scientists Develop An Interactive Medical Training Program For Special Operations Forces

Corpsmen, medics, and other health-care providers attached to Special Operations forces are required to maintain their skills in a wide variety of areas. This is normally accomplished through group training classes. Providing group training classes for these personnel, however, poses a special problem. Typically, one corpsman or medic is attached to each Special Operations unit or platoon. These platoons are frequently required to be away from their home bases, often in distant and remote locations around the globe, for extended periods. Their missions are often in areas where there are no hospitals or other support facilities. Since the units usually

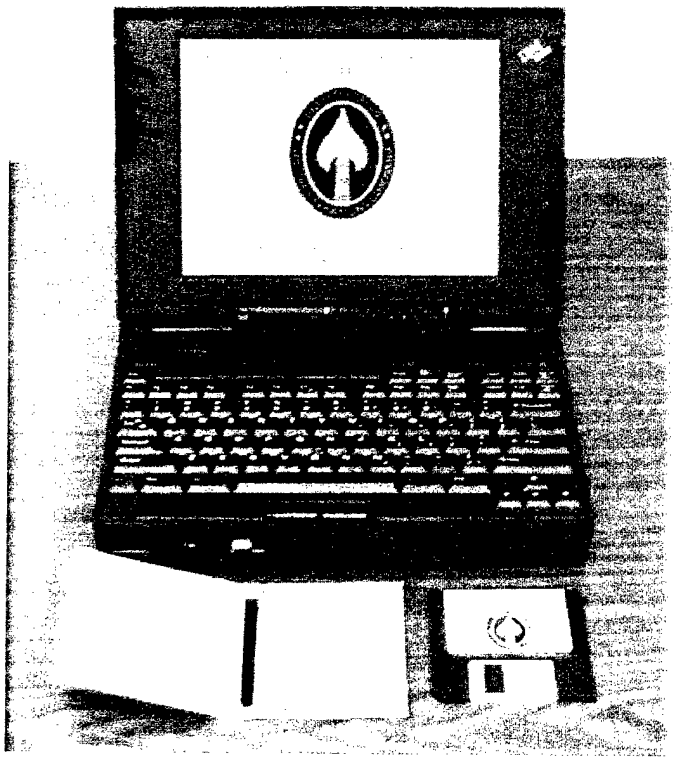


Special Operations personnel on maneuvers in the desert

operate independently, it is a rare occurrence when all the corpsmen and/or medics from a particular command are available for group training at the same time. Therefore, medical training needs to be provided on an individual basis without the scheduling restraints of a classroom setting. Mr. Larry Hermansen and Ms. Hoa Ly of the Naval Health Research Center have developed a computer-based, interactive medical training system as an alternative to classroom training.

The Special Operations Interactive Medical Training Program (SOIMTP) was designed to meet this goal. SOIMTP is a specialized interactive system with thousands of question-and-answer items in a variety of subject areas, or modules, that are relevant to Special Operations medical personnel. Each module has approximately 100 multiple-choice ques-

tions. The questions were developed by medical officers and senior hospital corpsmen with special knowledge of the subject areas and the unique environments in which Special Operations are conducted. The first prototype system, released in 1994, consisted of three training modules (Diving Medicine, Exercise Injuries, and Combat Casualty Care). This system was developed for hospital corpsmen attached to Naval Special Warfare units. After successful testing in the field, a second version with 18 modules was developed. The second version, released in March 1995, was distributed to Naval Special Warfare units and to medical personnel attached to Marine Corps, Air Force, and Army Special Operations forces. The third version, with 20 modules, was distributed in October 1996. It is presently being used by medical personnel from all services under the U.S. Special Operations Command.



SOIMTP is provided to users on a floppy disk and can be installed on almost any standard personal computer. The disk comes in a specially designed folder, that fits in a shirt pocket and has a quick reference user's guide printed on the inside. SOIMTP first allows the user to pick a subject area or module from the main menu.

Examples of the modules include Preventive Medicine, Casualty Management, Exercise Injuries, and Pharmacology. The user may also choose either the "practice" or "test" mode for the session. In the "practice" mode, the user can attempt each question as many times as necessary and is not allowed to continue on to the next question until the correct answer has been selected. When the correct answer has been selected, the program notifies the user and provides a reference so the user can verify the correct choice or learn more about the topic of that particular question. In the "test" mode, the user is allowed only one chance to answer each question before the next question is presented. The program keeps score and, at the end of the session, the scores are presented along with the user's response to each item and whether the response was correct or incorrect. These scores can be saved or printed.

The training accomplished via the SOIMTP may ultimately save lives by helping to improve the knowledge and skills of primary medical-care personnel attached to Special Operations forces. This project is funded by the U.S. Special Operations Command, through the Naval Medical Research and Development Command. The program manager is CAPT Frank K. Butler, Naval Special Warfare Command, chairman of the United States Special Operations Command Biomedical Research and Development Program.

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